

# PATENT ABSTRACTS OF JAPAN

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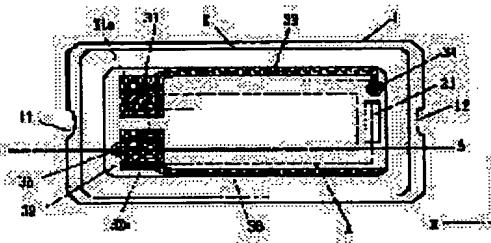
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## (54) PIEZOELECTRIC VIBRATOR

### (57)Abstract:

**PURPOSE:** To provide a piezoelectric vibrator with improved reliability for which an oscillation frequency does not differ depending on the connection direction of a terminal even when the vibrator is built in an oscillation circuit in the extremely small-sized piezoelectric vibrator.

**CONSTITUTION:** Electrodes 31 and 32 for connection are provided parallelly in a lateral direction Y leaned on one side in a longitudinal direction Y on an insulated substrate 1. The electrode 32 for connection is conducted with a back surface electrode by a via 35 and a dummy electrode 38 of an area corresponding to a draw-around electrode 33 is extended near the other end of the longitudinal direction. The electrode 31 for connection is conducted through the draw-around electrode 33 and the via 34 with the back surface electrode 37. An excitation electrode is formed and a crystal vibrating plate 4 for which a pull-out electrode is pulled out to one end is electrically and mechanically connected with the electrodes for connection.



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**CLAIMS**

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**[Claim(s)]**

**[Claim 1]** A piezoelectric transducer characterized by making almost the same capacity formed with said external leading electrode in a piezoelectric transducer which has an insulating substrate which prepared at least two external leading electrodes, and a piezo-electric diaphragm with which at least two excitation electrodes by which electrical installation is carried out to an electrode for these external derivation were formed.

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## DETAILED DESCRIPTION

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### [Detailed Description of the Invention]

#### [0001]

[Industrial Application] This invention relates to the piezoelectric transducer in consideration of the reliability of the actuation when including especially in an oscillator circuit about the piezoelectric transducer used as the source of a criteria oscillation of communication equipment, or a source of a clock of a microcomputer.

#### [0002]

[Description of the Prior Art] With the miniaturization of electronic equipment, electronic parts are small and to be mounted in high density on the front face on a printed-circuit board is demanded. Also in the field of a piezoelectric transducer, the small thin surface mount mold quartz resonator as this shows to drawing 7 instead of an exception is invented. In addition, drawing 8 is the B-B cross section of drawing 7, and drawing 9 is the bottom plan view of drawing 7. The Xtal diaphragm 81 which takes the support gestalt of the cantilever from which the drawer electrode of a couple was drawn by the one direction in order to secure an oscillating field, even when this quartz resonator is small, It becomes the upper surface from the insulating substrates 84 with which 82 and 83 were formed of technique, such as metallizing, such as an electrode for connection, the Xtal diaphragm 81 is directly carried on this electrode for connection, without using the base material used in the former, and it has composition joined with the conductive jointing material for corrugated fibreboard 85. The electrode 83 for connection is pulled out by the longitudinal direction end section of a surface mount mold quartz resonator, and is drawn by the rear-face electrode 88 on the back. Moreover, the electrode 82 for connection is pulled out by this other end through the leading-about electrode 87, and is drawn by the rear-face electrode 89 on the back. And the cap 86 was performing the hermetic seal. Thus, by adopting the configuration which derives a drawer electrode to an one direction, it was possible to have secured an oscillating field also in the miniaturized Xtal diaphragm.

#### [0003]

[Problem(s) to be Solved by the Invention] With the above-mentioned configuration, to the drawer electrode on the Xtal diaphragm drawing to the one direction, the external leading electrode (terminal) of the quartz resonator which packaging was carried out and was completed is prepared in the ends of a longitudinal direction, and as shown in drawing 7, it needed to take about one external leading electrode even on another side of a longitudinal direction in the interior of vibrator. However, when it included in a typical oscillator circuit as shows such a quartz resonator to drawing 4, it had the trouble that oscillation

frequency differed slightly, according to the direction which connects an external leading electrode (terminal). It is considered to be one factor that capacity is formed in the rear-face inter-electrode to which this is connected with a Xtal diaphragm-like drawer electrode edge and the drawer electrode concerned since the leading-about electrode was formed through an insulating substrate. The difference of this oscillation frequency had appeared notably [ when especially a load-carrying-capacity value is small ].

[0004] Although the vibrator concerned is built into an one direction in the micro piezoelectric transducer of a configuration of having drawn the drawer electrode in an oscillator circuit in order to secure a plane-of-vibration product when it is made in order that this invention may solve the above-mentioned trouble, and it miniaturizes, it aims at offering the reliable piezoelectric transducer from which oscillation frequency does not differ according to the connection direction of a terminal.

[0005]

[Means for Solving the Problem] In order to solve the above-mentioned trouble, a piezoelectric transducer by this invention has an insulating substrate which prepared at least two external leading electrodes, and a piezo-electric diaphragm with which at least two excitation electrodes by which electrical installation is carried out to an electrode for these external derivation were formed, and is characterized by making almost the same capacity formed with said external leading electrode.

[0006]

[Function] In the former, as shown in drawing 5, the capacity C1 by existence of an external leading electrode had become the configuration seemingly attached only to one of the two of a piezoelectric transducer. Since it is wiring so that it may become almost the same, as the capacity of the external leading electrode formed on the insulating substrate of making area of an external leading electrode almost the same etc., for example is shown in drawing 6 according to this invention, capacity C1 and C2 formed with the external leading electrode prepared in the ends of a piezoelectric transducer Q can be made equal, and it stops however, having directivity electrically. Although included in an oscillator circuit in the direction of a terminal of the flume gap which is such a piezoelectric transducer, since there is no difference in the capacity value which appears in the ends of a piezoelectric transducer, oscillation frequency is also changeless.

[0007]

[Example] The quartz resonator of the surface mount mold which used the AT cut quartz plate about the 1st example of this invention is taken for an example, and it explains with reference to a drawing. Drawing 1 is the plan showing the 1st example of this invention, drawing 2 is an A-A cross section in the condition of having closed the structure of drawing 1 with a cap, and drawing 3 is rear-face drawing of drawing 1. The insulating substrate 1 consists of an alumina of the rectangle configuration whose thickness is about 0.6mm, and notching 11 and 12 is formed in the ends of a longitudinal direction. Near the periphery of this insulating substrate 1, the alumina coat 2 with a thickness of about 30 micrometers is formed by the shape of a periphery. Among this alumina coat, in the way, it inclines toward one side of a longitudinal direction X, and two electrodes 31 and 32 (some external leading electrodes) for connection are formed together with the direction Y of a short hand. The periphery-like electrodes 31a and 32a are respectively formed in the electrodes 31 and 32 for these connection, and the beer 35 (what prepared the breakthrough and filled this up with the metaled electrode material) which leads this electrode to the rear face of the insulating substrate 1 is formed on the electrode 32 for connection. The surface electrode

for connection has flowed with the rear-face electrode 36 with this beer 35. Moreover, the electrode 31 for connection is electrically connected with the beer 34 prepared in the another side edge of a longitudinal direction with the leading-about electrode 33, and has flowed through the surface electrode for connection with the rear-face electrode 37 with this beer. From the electrode 32 for connection, the dummy electrode 38 of the area corresponding to said leading-about electrode 33 is prolonged even near the another side edge of a longitudinal direction. The electrode 31 for connection, the leading-about electrode 33 (some of one external leading electrodes are constituted) and the electrode 32 for connection, and the dummy electrode 38 (some external leading electrodes of another side are constituted) pass along the center of the direction Y of a short hand of an insulating substrate, and are carrying out the electrode configuration of axial symmetry mostly to the line which extends in a longitudinal direction. The electrode for these connection, a leading-about electrode, and a dummy electrode carry out metallizing of the tungsten, it is the configuration which gold-plated on this upper surface at the nickel-plating list, and, in the thickness of the electrode for connection, it of about 30 micrometers, a leading-about electrode, and a dummy electrode makes thickness of about 15 micrometers and the electrode for connection equal to the thickness of said alumina coat. Moreover, the height 21 for carrying the another side edge of the Xtal diaphragm mentioned later in the other end of a longitudinal direction X is formed. Although the dotted line shows, one pair of excitation electrodes are formed in the table rear face of a rectangle-like AT cut quartz plate, and, as for the Xtal diaphragm 4, the drawer electrode is pulled out by the one side edge of a longitudinal direction X from the excitation electrode. This Xtal diaphragm 4 is constructed over said electrode for connection and said height 21, and the conductive jointing material for corrugated fibreboard 5 of a polyimide system with which viscosity, an amount, etc. were adjusted appropriately is applied in the electrode side for connection. The cap 6 is carrying out the configuration of the product made from an alumina, and a reverse concave, and the periphery size is designed equally to the size of said alumina coat. And this alumina coat and cap are joined with low melting glass 61, and it is closed in airtight.

[0008] Next, the comparison data of elegance is explained with drawing 10 this invention article and conventionally. Drawing 10 is a graph which sets to the quartz resonator of the surface mount mold which adopted the insulating substrate of the external leading electrode configuration of a configuration of being shown in the above-mentioned conventional example, and it which adopted the insulating substrate of the external leading electrode configuration of a configuration of being shown in the above-mentioned example, and shows the frequency rate of change of a right-and-left \*\*\*\*\* case for the path of insertion of the quartz resonator in an oscillator circuit. In drawing 10, A of each element of a horizontal axis shows the conventional example, and B shows this invention article. In the case of (load-carrying-capacity CL) 5.48pF, 1A is the average of the frequency rate of change of 50 measurement sizes in elegance at the nominal frequency of 24MHz conventionally, and 1B is the average in these conditions in this invention article. In the case of (load-carrying-capacity CL) 11.5pF, 2A is the average of the frequency rate of change of 50 measurement sizes in elegance at the nominal frequency of 24MHz conventionally, and 2B is the average in these conditions in this invention article. Even if this invention article changes the path of insertion of a piezoelectric transducer from drawing 10 to an oscillator circuit, that there is almost no change of oscillation frequency can understand clearly.

[0009] In addition, in the above-mentioned example, although explained taking the case of the quartz resonator of a surface mount mold, this invention can be applied also to vibrator other than a surface mount mold, and may be other piezoelectric material, such as a piezo-electric ceramic vibrator. Moreover,

what is necessary is not to limit the external leading electrode configuration and number which are formed on an insulating substrate to the above-mentioned example, either, and just to change them suitably with the configuration of a package, the configuration of a piezo-electric diaphragm, size, etc. When the thickness of an insulating substrate differs selectively and some external leading electrodes are formed in this portion like forming the oscillating space of a piezo-electric diaphragm in an insulating substrate especially, the capacity formed also differs. In such a case, it is necessary to set up capacity value with the means of adjusting the area of each external leading electrode.

[0010]

[Effect of the Invention] According to this invention, by the former, as shown in drawing 5, the capacity by existence of an external leading electrode had become the configuration seemingly attached only to one of the two of a piezoelectric transducer. Since it is wiring so that it may become almost the same, as the capacity of the external leading electrode formed on the insulating substrate of the area of an external leading electrode making it almost the same etc. is shown in drawing 6, for example according to this invention, capacity value formed with the external leading electrode prepared in the ends of a piezoelectric transducer can be made equal, and it stops however, having directivity electrically. Although it includes in an oscillator circuit that it is such a piezoelectric transducer, since there is no difference in the capacity value which appears in the ends of a piezoelectric transducer according to the direction of a terminal, oscillation frequency is also changeless. Therefore, even when a load-carrying capacity value is small, the oscillation frequency stabilized as a whole can be obtained, and a reliable piezoelectric transducer can be obtained.

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## DESCRIPTION OF DRAWINGS

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### [Brief Description of the Drawings]

[Drawing 1] The plan showing the surface mount mold quartz resonator by the example of this invention.

[Drawing 2] The A-A cross section in the condition of having closed with a cap in drawing 1.

[Drawing 3] Bottom plan view drawing of drawing 1.

[Drawing 4] The circuit diagram showing a general oscillator circuit.

[Drawing 5] Drawing showing the capacity of the piezoelectric transducer by the conventional example which appears in an edge on the other hand.

[Drawing 6] Drawing showing the capacity which appears in the ends of the piezoelectric transducer by this invention.

[Drawing 7] The plan showing the surface mount mold quartz resonator of the conventional example.

[Drawing 8] The B-B cross section in the condition of having closed with a cap in drawing 7.

[Drawing 9] The bottom plan view of drawing 7.

[Drawing 10] The graph which shows comparison data.

### [Description of Notations]

1 Insulating Substrate

2 Alumina Coat

21 Height

31 32 Electrode for connection

33 Leading-about Electrode

38 Dummy Electrode

31a, 32a Periphery-like electrode

4 81 Xtal diaphragm (piezo-electric diaphragm)

5 85 Conductive jointing material for corrugated fibreboard

6 86 Cap

5 85 Low melting glass

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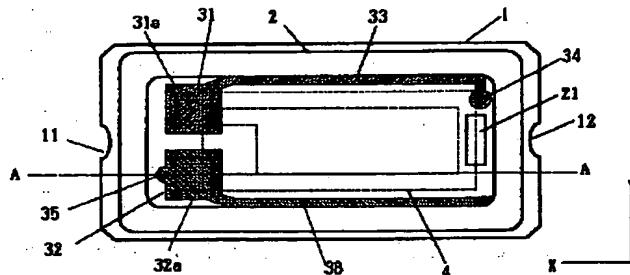
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(54) [発明の名称] 圧電振動子

(57) 【要約】

**【目的】** 超小型の圧電振動子において、当該振動子を発振回路に組み込んでも、端子の接続方向によって発振周波数が異なる、信頼性の高い圧電振動子を提供する。

**【構成】** 絶縁性基板1には、長手方向Xの一方に片寄って接続用電極31、32が短手方向Yに並んで設けられている。接続用電極32はピア35により裏面電極と導通し、また引き回し電極33に対応する面積のダミー電極38が長手方向の他方端近傍にまで延びている。接続用電極31は引き回し電極33、ピア34を介して裏面電極37と導通している。励振電極が形成され、引出電極を一方端に引きだした水晶振動板4を前記接続用電極と電気的機械的に接続する。



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## 【特許請求の範囲】

【請求項1】 少なくとも2つの外部導出電極を設けた絶縁性基板と、これら外部導出用電極と電気的接続される少なくとも2つの励振電極が形成された圧電振動板とを有する圧電振動子において、前記外部導出電極によって形成される容量をほぼ同一としたことを特徴とする圧電振動子。

## 【発明の詳細な説明】

## 【0001】

【産業上の利用分野】本発明は通信機器の基準発振源、あるいはマイクロコンピュータのクロック源として用いられる圧電振動子に関し、特に発振回路に組み込んだときの動作の信頼性を考慮した圧電振動子に関するものである。

## 【0002】

【従来の技術】電子機器の小型化に伴い、電子部品は小型でかつプリント配線基板上にその表面で高密度に実装されることが要求されている。圧電振動子の分野においてもこれは例外ではなく、例えば図7に示すような小型で薄型の表面実装型水晶振動子が発明されている。なお、図8は図7のB-B断面図、図9は図7の底面図である。この水晶振動子は、小型でも振動領域を確保するために一対の引出電極が一方向に導出された片持ちの支持形態をとる水晶振動板81と、上面に接続用電極等82、83がメタライズ等の手法によって形成された絶縁性基板84とからなり、従来では用いられていた支持体を用いずに、直接、この接続用電極上に水晶振動板81を搭載し、導電性接合材85で接合した構成となっている。接続用電極83は表面実装型水晶振動子の長手方向一端部に引き出され裏面の裏面電極88に導出されている。また接続用電極82は引き回し電極87を介して同他端部に引き出され裏面の裏面電極89に導出されている。そして、キャップ86にて気密封止を行っていた。このように引出電極を一方向へ導出する構成を採用することにより、小型化された水晶振動板においても振動領域を確保することが可能となっていた。

## 【0003】

【発明が解決しようとする課題】上記構成では水晶振動板上の引出電極が一方向へ導出しているのに対して、パッケージングされ完成した水晶振動子の外部導出電極（端子）は、長手方向の両端に設けられており、図7に示すように振動子内部において一方の外部導出電極を長手方向の他方にまで引き回す必要があった。しかしながら、このような水晶振動子を図4に示すような代表的な発振回路に組み込んだ場合、外部導出電極（端子）を接続する方向によって、発振周波数がわずかに異なるという問題点を有していた。これは、引き回し電極が形成されたために、水晶振動板状の引出電極端と該引出電極とつながる裏面電極間に絶縁性基板を介して容量が形成されることが1つの要因と考えられる。この発振周波数

の相違は、特に負荷容量値が小さいときに顕著に現れていた。

【0004】本発明は上記問題点を解決するためになされたもので、小型化した場合、振動面積を確保するために一方向へ引出電極を導出した構成の超小型の圧電振動子において、当該振動子を発振回路に組み込んでも、端子の接続方向によって発振周波数が異ならない、信頼性の高い圧電振動子を提供することを目的としている。

## 【0005】

【課題を解決するための手段】上記問題点を解決するために、本発明による圧電振動子は、少なくとも2つの外部導出電極を設けた絶縁性基板と、これら外部導出用電極と電気的接続される少なくとも2つの励振電極が形成された圧電振動板とを有し、前記外部導出電極によって形成される容量をほぼ同一としたことを特徴とする。

## 【0006】

【作用】従来では図5に示すように、外部導出電極の存在による容量C1が見かけ上圧電振動子の片方にのみついた構成となっていた。しかし、本発明によれば、例えば、外部導出電極の面積をほぼ同一にする等により、絶縁基板上に形成された外部導出電極の容量をほぼ同一となるように配線しているため、図6に示すように圧電振動子Qの両端に設けられた外部導出電極により形成される容量C1、C2を等しくすることができ、電気的に方向性を持たなくなる。このような圧電振動子であるといずれの端子方向で発振回路に組み込んでも、圧電振動子の両端に現れる容量値に差異がないため、発振周波数も変化がない。

## 【0007】

【実施例】本発明の第1の実施例についてATカット水晶板を用いた表面実装型の水晶振動子を例にとり、図面を参照して説明する。図1は本発明の第1の実施例を示す平面図であり、図2は図1の構造をキャップにて封止した状態におけるA-A断面図であり、図3は図1の裏面図である。絶縁性基板1は例えば厚みが約0.6mmの長方形形状のアルミナからなり、長手方向の両端には切り欠き11、12が設けられている。この絶縁性基板1の外周近傍には周状で厚さ約30μmのアルミナコート2が設けられている。このアルミナコートの内方においては、長手方向Xの一方に片寄って2つの接続用電極31、32（外部導出電極の一部）が短手方向Yに並んで設けられている。これら接続用電極31、32には、各々周状電極31a、32aが設けられており、接続用電極32上にはこの電極を絶縁性基板1の裏面へ導くビア35（貫通孔を設けこれに金属の電極材料を充填したもの）が設けられている。このビア35により表面の接続用電極は裏面電極36と導通している。また、接続用電極31は引き回し電極33により長手方向の他端に設けられたビア34に電気的につながっており、またこのビアにより表面の接続用電極は裏面電極37と導通し

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ている。接続用電極 3 2 からは前記引き回し電極 3 3 に対応する面積のダミー電極 3 8 が長手方向の他方端近傍にまで延びている。接続用電極 3 1 と引き回し電極 3 3 (一方の外部導出電極の一部を構成)、接続用電極 3 2 とダミー電極 3 8 (他方の外部導出電極の一部を構成)は絶縁性基板の短手方向 Y の中心を通り、長手方向に延在する線に対して、ほぼ線対称の電極形状をしている。これら接続用電極、引き回し電極、ダミー電極は例えばタングステンをメタライズし、この上面にニッケルメッキ並びに金メッキを行った構成であり、接続用電極の膜厚は約  $30 \mu\text{m}$ 、引き回し電極、ダミー電極のそれは約  $15 \mu\text{m}$  と接続用電極の厚みを前記アルミニナコートの膜厚と等しくしている。また、長手方向 X の他端部に、後述する水晶振動板の他方端を搭載するための突起部 2 1 が設けられている。点線で示しているが、水晶振動板 4 は矩形状の A T カット水晶板の表裏面に 1 対の励振電極が形成され、励振電極からは引出電極が長手方向 X の一方端に引き出されている。この水晶振動板 4 は前記接続用電極と前記突起部 2 1 に架設され、接続用電極側では適切に粘度、量等が調整された例えればポリイミド系の導電性接合材 5 が塗布されている。キャップ 6 はアルミニナ製で逆凹型の形状をしており、その外周寸法は前記アルミニナコートの寸法と等しく設計されている。そして、低融点ガラス 6 1 にてこのアルミニナコートとキャップを接合し、気密的に封止される。

【0008】次に、本発明品と従来品の比較データを図 10とともに説明する。図 10 は、上記従来例に示す構成の外部導出電極構成の絶縁性基板を採用した表面実装型の水晶振動子と、上記実施例に示す構成の外部導出電極構成の絶縁性基板を採用したそれにおいて、発振回路中における水晶振動子の挿入方向を左右変えた場合の周波数変化率を示すグラフである。図 10 のなかで、横軸の各要素の A は従来例を示し、B は本発明品を示す。1 A は従来品において公称周波数  $2.4 \text{ MHz}$  で負荷容量 (CL)  $5.43 \text{ pF}$  の場合で、サンプル数 50 個の周波数変化率の平均値であり、1 B は本発明品において同条件での平均値である。2 A は従来品において公称周波数  $2.4 \text{ MHz}$  で負荷容量 (CL)  $1.15 \text{ pF}$  の場合で、サンプル数 50 個の周波数変化率の平均値であり、2 B は本発明品において同条件での平均値である。図 10 から本発明品は、発振回路に対し圧電振動子の挿入方向を異ならせても、ほとんど発振周波数の変化がないことが明らかに理解できる。

【0009】なお、上記実施例において、表面実装型の水晶振動子を例にとり説明したが、本発明は表面実装型以外の振動子にも適用できるし、圧電セラミック振動子等の他の圧電材料であってもよい。また、絶縁性基板上に形成される外部導出電極構成、数も上記実施例に限定されるものではなく、パッケージの構成、圧電振動板の形状、サイズ等により適宜変更すればよい。特に、絶縁

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性基板に圧電振動板の振動空間を形成する等のように、絶縁性基板の厚みが部分的に異なり、この部分に外部導出電極の一部が形成されている場合、形成される容量も異なる。このような場合は、各外部導出電極の面積を調整する等の手段により容量値を設定する必要がある。

### 【0010】

【発明の効果】本発明によれば、従来では図 5 に示すように、外部導出電極の存在による容量が見かけ上圧電振動子の片方にのみついた構成となっていた。しかし、本発明によれば、例えれば、外部導出電極の面積がほぼ同一にする等により、絶縁基板上に形成された外部導出電極の容量をほぼ同一となるように配線しているため、図 6 に示すように圧電振動子の両端に設けられた外部導出電極により形成される容量値を等しくすることができ、電気的に方向性を持たなくなる。このような圧電振動子であると発振回路に組み込んでも端子方向により圧電振動子の両端に現れる容量値に差異がないため、発振周波数も変化がない。よって、負荷容量値が小さい場合でも、全体として安定した発振周波数を得ることができ信頼性の高い圧電振動子を得ることができる。

### 【図面の簡単な説明】

【図 1】本発明の実施例による表面実装型水晶振動子を示す平面図。

【図 2】図 1 においてキャップにて封止した状態の A-A 断面図。

【図 3】図 1 の底面図。

【図 4】一般的な発振回路を示す回路図。

【図 5】従来例による圧電振動子の一方端に現れる容量を示す図。

【図 6】本発明による圧電振動子の両端に現れる容量を示す図。

【図 7】従来例の表面実装型水晶振動子を示す平面図。

【図 8】図 7 においてキャップにて封止した状態の B-B 断面図。

【図 9】図 7 の底面図。

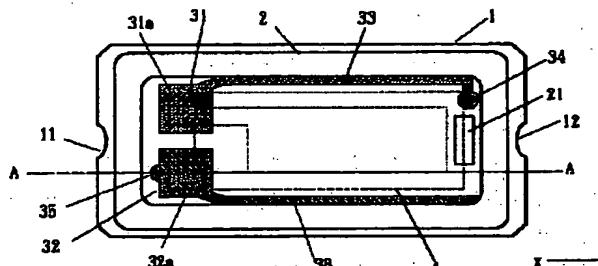
【図 10】比較データを示すグラフ。

### 【符号の説明】

- 1 絶縁性基板
- 2 アルミニナコート
- 2 1 突起部
- 3 1, 3 2 接続用電極
- 3 3 引き回し電極
- 3 8 ダミー電極
- 3 1 a, 3 2 a 周状電極
- 4, 8 1 水晶振動板 (圧電振動板)
- 5, 8 5 導電性接合材
- 6, 8 6 キャップ
- 5, 8 5 低融点ガラス

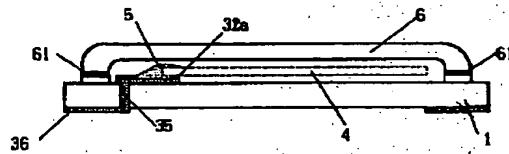
(4)

【図1】



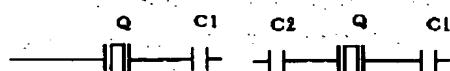
【図3】

【図2】

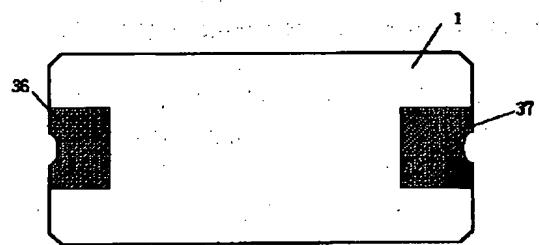


【図5】

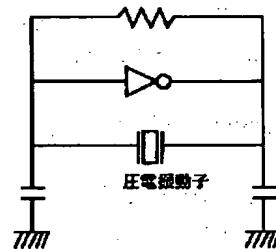
【図6】



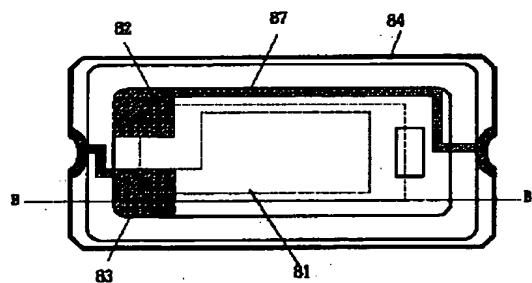
【図4】



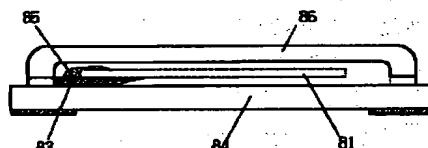
【図7】



【図8】



【図9】



【図10】

